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ARCTIC SEA ICE STUDIES WITH
PASSIVE MICROWAVE SATELLITE OBSERVATIONS

by

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The objectives of this research are: (1) to improve sea ice concentration determinations from passive microwave space observations; (2) to study the role of Arctic polynyas in the production of sea ice and the associated salinization of Arctic shelf water; and (3) to study large-scale sea ice variability in the polar oceans. The strategy is to analyze existing data sets and data acquired from both the DMSP SSM/I and recently completed aircraft underflights. Special attention will be given the high resolution 85.5 GHz SSM/I channels for application to thin ice algorithms and processes studies.

A study relating the fluctuations in the sea ice areas of the Bering and Okhotsk seas to changes in the position and intensity of quasi-stationary high and low pressure systems associated with large-scale standing wave patterns in the atmosphere has been completed and published (Cavalieri and Parkinson, 1987). Other work recently completed include a comparison of SIR-B and SMMR Weddell Sea ice concentrations (Martin, et al., 1987) and a study of how ice surface conditions, imaging geometry and choice of algorithm parameters affect the computation of sea ice concentrations using both active and passive microwave sensors (Burns, et al., 1987). Most recently,

and as part of the NASA DMSP SSM/I Sea Ice and Snow Validation Program, a series of coordinated aircraft SSM/I underflights with three aircraft were completed in March 1988. NASA's DC-8 airborne laboratory carried both active and passive microwave sensors. The DC-8 radiometers with frequencies and polarizations that closely match those of the SSM/I were developed and operated by Goddard's Microwave Sensors and Data Communication Branch under the direction of Dr. T. T. Wilheit. The active sensors on the DC-8 included the JPL P-, L-, and C-band SAR. Two Navy research aircrafts also participated in these underflights in support of the NASA program and provided additional passive and active microwave coverage.

Analysis of aircraft and satellite data sets is expected to provide a basis for determining the potential of the SSM/I high frequency channels for improving sea ice algorithms and for investigating oceanic processes. Improved sea ice algorithms will aid the study of Arctic coastal polynyas which in turn will provide a better understanding of the role of these polynyas in maintaining the Arctic watermass structure. Analysis of satellite and archived meteorological data sets will provide improved estimates of annual, seasonal and shorter-term sea ice variability.

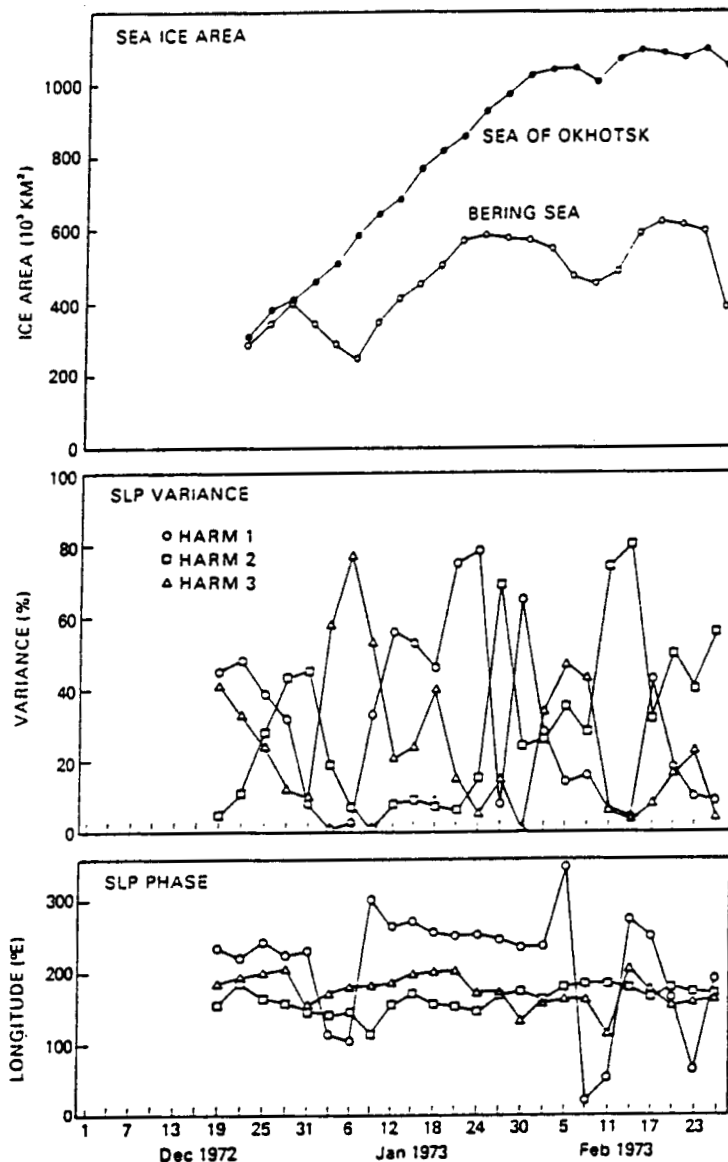


Figure 1. Time series of the sea ice covered areas in the Bering and Okhotsk seas, percent variance, and the longitudinal phases of the first three harmonics of a zonal Fourier analysis of the atmospheric sea level pressure for the Winter of 1972-73. The phase of each harmonic corresponds to the position of minimum amplitude or low pressure. Two midwinter Bering Sea ice retreats starting on December 28 and January 27, respectively, are preceded by a reduction in the variance explained by harmonic one and an increase in the variance explained by harmonics two and three. Rapid changes in the phases of these harmonics are also observed and are associated with changes in the position of both the Aleutian Low and the Siberian High, two wintertime semi-permanent circulation features. The direction of the winds associated with these two systems determine whether the ice advances or retreats these two seas (Cavalieri and Parkinson, 1987).